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ABSTRACT

Three experiments on the comprehension and acquisition of temporal terms are described. Methodological innovations were applied to control for possible methodological effects on children's performance. Each experiment involved 24 children aged 3 to 5. In the first experiment, subjects manipulated toys in response to instructions containing the words "before" or "after." Due to methodological adjustments, the children displayed unprecedented understanding of the temporal terms. The second study used a game against a clock to determine the acquisition order of "before" and "while/when." In response to experimenters' questions, the younger children preferred to use the concept of simultaneity while the older children preferred the concept of precedence. The results also demonstrated that most children have mastered the temporal term "before" by age five. The third experiment demonstrated that most children acquired the term "after" by age five. The results provide evidence of early mastery of both comprehension and production of temporal terms and support for learnability theory and the innateness hypothesis of language acquisition. (RW)

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Temporal Terms: Mastery by Age Five

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Language acquisition research can shed light on learnability theory in at least three ways, providing sources of data about the rate, order, and extent of hypothesis testing in the acquisition process. One tenet of learnability theory is the innateness hypothesis. This predicts rapid, stepwise acquisition, based on a highly constrained set of principles which promote grammar formation.

The innateness hypothesis has been somewhat discredited recently by studies in which children apparently fail to comprehend some types of sentences. However, children's failures in performance can reflect methodological oversights on the researchers' part, not a lack of grammatical competence. In several instances improved experimental paradigms have resulted in a revised picture of children's emerging grammatical competence, one which supports the innateness hypothesis. This paper reports on the application of some of these methodological innovations to yet another linguistic ability, the comprehension and production of temporal terms. The results of the experiments described below provide evidence of early mastery in both comprehension and production, as predicted by learnability theory.

This research is an extension of work done in collaboration with Henry Hamburger. Our research has provided evidence of rapid and almost error-free advances toward an appropriate adult grammar in the acquisition of restrictive relative clauses and noun phrases with a variety of modifying terms, eg. ordinals and superlatives. The procedures and the results of comprehension and production studies on the acquisition of restrictive relative clauses are explained in detail in Hamburger and Crain (1982).

Correcting an Error of Omission in Comprehension Tasks

Most relevant research has led to the conclusion that even five- and six-year-olds often fail to comprehend sentences containing the temporal terms before and after. (A noteworthy exception is the work of Lucia French.) One source of difficulty with some sentences resides in cognitive demands beyond those imposed by their structural or semantic properties. For example, the conceptual ordering of the events depicted in some

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sentences is opposite the order in which these events are mentioned. This conflict between order-of-mention and conceptual order characterizes sentences (1) and (2), but not (3) and (4).

(1) Before the boy patted the dog, he jumped the gate.

(2) The boy jumped the gate after he patted the dog.

(3) Move a blue plane before you move a red plane.

(4) After you move a red plane, move a blue plane.

Much of the research on the acquisition of temporal terms has focused on perceptual strategies children employ when they are unable to process them correctly. In comprehension tasks using sentences like (1) and (2), children frequently acted out the events in the order they were mentioned (cf. Clark, 1971). A different strategy emerged in response to simplified sentences like (3) and (4). Children often failed to act out the subordinate clause, purportedly attending only to the main clause (cf. Amidon and Carey, 1972). Explanations for these responses evoke syntactic, semantic, pragmatic and task factors. The common thread is the conclusion that these sentences present processing difficulties for children. Pragmatic and task requirements were assumed to be responsible for the particular processing strategy adopted under duress.

An alternative view is that the comprehension tasks themselves were responsible for children's errors. On this view, the oversight in previous research was a failure to attend to the pragmatic function of before and after. These temporal terms are commonly used in sentences like (3) and (4) after the hearer has established her intent to perform the action mentioned in the subordinate clause. The utterance of sentence (3) is felicitous, when used in this way, only if the hearer has expressed the intention to move a red plane. If this use of these temporal terms is mastered by children before other, more abstract uses, then the absence of the requisite context could interfere with normal processing. On the other hand, the satisfaction of this felicity condition on these terms could reduce or eliminate the alleged acquisition errors, bringing children's performance in line with their linguistic competence.

Experiment I.

Twenty-four children ranging in age from 3;10 to 5;0 participated in a comprehension experiment designed to satisfy the felicity conditions for sentences containing before and after. Each child was randomly assigned one of four lists. Each list contained eight sentences, two each of four sentence types, ie. sentences like (3) and (4) above, as well as simpli-

fied versions of (1) and (2). The experimental workspace contained eight vehicles in a line. The experimenter explained to the child that they were going to play a game in which she would move vehicles as instructed in sentences spoken by the experimenter.

The felicity condition for temporal terms was satisfied by asking the child before each trial to identify one of the vehicles to be used on that trial. In this way the requisite intention to play with something, missing in previous research, was established. The experimenter then mentioned this action in the target sentence. So, if the child expressed her desire to play with the bus, the experimenter would incorporate this into the sentence used on that trial, eg. "Before you push the bus, push the helicopter."

Children displayed unprecedented understanding of before and after in this experiment. Correct responses were produced 82% of the time. An analysis by age showed a significant increase in correct responses by the older children (n = 12, ages = 4;5 - 5;0). This group produced 88% correct responses overall and 79% correct responses to sentences like (1) and (2) which commonly resulted in errors of reversal or omission in previous studies.

Eliciting Temporal Terms

The mastery of a linguistic construction includes meaningful production as well as comprehension. Even if comprehension tasks can be refined enough to reveal children's understanding of linguistic constructions, reliable assessment of their productions is needed. Moreover, elicited production tasks avoid many of the methodological problems which arise in comprehension tasks, since experimental inputs are often easier to control finely than are a subject's responses. Nevertheless, spontaneous and elicited production studies are rarely used, presumably because children fail to produce complex utterances when simpler ones suffice. For instance, instead of producing utterances with before, children often use then, just now, or first.

Following the methods outlined in Hamburger and Crain (1982), elicited production tasks were designed for the temporal terms before, after, and while/when. In general, elicited production tasks require the experimenter to create contexts in which just the term under investigation, but not simpler ones, is appropriate. However, a procedural innovation is needed to delineate sequential acquisition. Contexts are required in which a select set of alternative linguistic forms are admissable. In these circumstances, different productions by children of different ages can be viewed as a reflection of

their developing grammars. Contexts of this sort, admitting of two forms, were constructed to assess children's acquisition of temporal terms.

Experiment II.

The selection of forms for this experiment was inspired by Eve Clark's Semantic Feature Theory (Clark, 1971). One prediction of this theory is that the concept of simultaneity is acquired before the concept of precedence. To test this, contexts were designed in which only sentences containing the temporal terms while/when, or before were appropriate. The situation included a simple game and an audible clock. The child was introduced to the game by demonstration, the experimenter commenting only on the outcome, eg. "I was a winner that time." After playing several games against the clock the experimenter asked what one does to win, or why the player was a winner or loser on the last attempt. There are two ways of describing how one plays, as sample productions (5) and (6) illustrate:

T. 3;10 (5) Because the clock goes, when you wait the clock stops right when you are going.

M. 4;11 (6) I got it through the basket before it runned out.

Twenty-four children ranging in age from 3;10 to 5;10 participated in this experiment. Twenty-one of these children used either before or while/when in response to the experimenter's questions. To test for acquisition order, children were assigned to one of two age groups, with the same number of children in each. The mean age for one group was 4;3. For the other it was 5;4. As predicted by Clark, these groups responded differently. Younger children preferred to use the concept of simultaneity in their productions (ie. while/when= 7/12), where older children used the concept of precedence (ie. before=9/12).

This change in response from one group to the next probably reflects the older children's realization that the sound made by the clock bore no essential role in determining the outcome of the game. Any demarcation of the end of the alloted time period would have served as well; therefore a response using before was deemed more appropriate. In fact, introducing a silent timer triggering a bell, instead of the audible clock, would make a response using while/when infelicitous. This modification of Experiment II, satisfying the appropriateness conditions for before alone, would allow the assessment of children's knowledge of before instead of their preferences for one temporal term over another. However, it is already clear from

this elicited production experiment that most children have mastered the temporal term before by age five.

Experiment III.

A production task was designed to elicit sentences containing the temporal term after. A consideration of two potential problems warranted the experimental procedures which were adopted. First, contexts in which after, but no other temporal term, is felicitous require that after be used as a preposition. Contexts which are appropriate for the use of after as a subordinate conjunction also admit when. Second, the task must ensure that the temporal and not the spatial sense of after underlies the child's utterance of this term in the experimental setting.

The following procedures were adopted. A number of figures and a small cage were placed in front of the child. The child was told that the figures wanted to go into the cage but that they must enter it in order. The experimenter pretended that on occasion one of them would wander away from the others. This figure would then ask the child for instructions about its position in the line and about its turn to enter the cage. At this point in the experiment the figure would ask "Where do I go?" and "Will you help me?" At another time the same figure would again wander and seek the child's assistance. This time it asked the child "When do I go?" and "Will you help me?"

Eighteen of the children who participated in Experiment II also took part in Experiment III. Nearly every child's response to the where question mentioned a spatial relation like behind or in front of. Only two children used after. In addition, their common response to the object's appeal for help was to place it back in line. In response to the when question, all but the youngest child used after as a preposition and responded to the appeal for help by putting the appropriate figures into the cage. These different responses to the different questions clearly establish that most children have acquired the temporal sense of after by age five.

Conclusion

This research substantially alters the current picture of the acquisition of temporal terms. It provides evidence of early mastery, both in comprehension and production. Acquisition also appears to be sequential, and relatively error-free. These results can be taken as support for learnability theory in general, and the innateness hypothesis in particular. It

is to be hoped that further uses of these comprehension and production tasks will continue the progress toward the reliable assessment of the development of human cognitive abilities.

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